

HAMILTON, BROOK, SMITH & REYNOLDS, P.C.

UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under
37 C.F.R. 1.53(b))

Attorney Docket No.

1958.2005-000

First Named Inventor or
Application Identifier

Lory Molesky

Express Mail Label No.

EL551544495US

Title of
Invention

INTERVAL-BASED ADJUSTMENT SYSTEM FOR DATABASES

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

ADDRESS TO:

Assistant Commissioner for Patents
Box Patent Application
Washington, D.C. 20231

1. ☒ Fee Transmittal Form
(Submit an original, and a duplicate for fee processing)
2. ☒ Specification **Total Pages 19**
(preferred arrangement set forth below)
 - Descriptive title of the invention
 - Cross References to Related Applications
 - Statement Regarding Fed sponsored R & D
 - Reference to microfiche Appendix
 - Background of the Invention
 - Summary of the Invention
 - Brief Description of the Drawings
 - Detailed Description
 - Claim(s)
 - Abstract of the Disclosure
3. ☒ Drawing(s) (35 U.S.C. 113) **Total Sheets 5**
☐ Formal ☒ Informal
4. ☒ Oath or Declaration/POA **Total Pages 6**
 - a. ☒ Newly executed (original or copy)
 - b. ☐ Copy from a prior application (37 C.F.R. 1.63(d))
(for continuation/divisional with Box 17 completed)
[NOTE Box 5 below]
 - i. ☐ DELETION OF INVENTOR(S)
Signed statement attached deleting
inventor(s) named in the prior
application, see 37 C.F.R. 1.63(d)(2)
and 1.33(b).
5. ☐ Incorporation By Reference (useable if Box 4b is checked)
The entire disclosure of the prior application, from which a
copy of the oath or declaration is supplied under Box 4b, is
considered as being part of the disclosure of the accompanying
application and is hereby incorporated by reference therein.

6. ☐ Microfiche Computer Program (Appendix)
7. ☐ Nucleotide and/or Amino Acid Sequence Submission
(if applicable, all necessary)
 - a. ☐ Computer Readable Copy
 - b. ☐ Paper Copy (identical to computer copy)
[] Pages
 - c. ☐ Statement verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

8. ☒ Assignment Papers (cover sheet & documents)
9. ☐ 37 C.F.R. 3.73(b) Statement ☐ Power of Attorney
(when there is an assignee)
10. ☐ English Translation Document (if applicable)
11. ☐ Information Disclosure Statement (IDS)/PTO-1449 ☐ Copies of IDS
Citations
12. ☐ Preliminary Amendment
13. ☒ Return Receipt Postcard (MPEP 503)
(Should be specifically itemized)
14. ☐ Small Entity Statement(s) ☐ Statement filed in prior application,
status still proper and desired
15. ☐ Certified Copy of Priority Document(s)
(if foreign priority is claimed)
16. ☐ Other: _____

17. If a **CONTINUING APPLICATION**, check appropriate box and supply the requisite information:

☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of prior application No.:

Prior application information: Examiner:

Group Art Unit:

18. CORRESPONDENCE ADDRESS

NAME	Rodney D. Johnson				
	HAMILTON, BROOK, SMITH & REYNOLDS, P.C.				
ADDRESS	Two Militia Drive				
CITY	Lexington	STATE	MA	ZIP CODE	02421-4799
COUNTRY	USA	TELEPHONE	(781) 861-6240	FAX	(781) 861-9540

Signature

Rodney D. Johnson

Date

August 17, 2000

Submitted by
Typed or Printed Name

Rodney D. Johnson

Reg. Number

36,558

-1-

Date: August 17, 2000 Express Mail Label No. EL551544495US

Inventors: Lory Molesky and Robert Hanckel

Attorney's Docket No.: 1958.2005-000

INTERVAL-BASED ADJUSTMENT SYSTEM FOR DATABASES

BACKGROUND

For many applications, data is stored in a database as a time series of data values. The data retrieved from the database may need to be adjusted for events. In particular, it may be desirable to apply an interval-based adjustment (IBA) to the data.

Examples of interval-based adjustments include the application of stock splits and currency conversions. Such adjustments may also be used to reflect dividend distributions from stocks and mutual funds. These adjustment triggers are typically infrequent events.

To reduce rounding and precision errors, the time series data is typically stored as unadjusted data values. When the data is stored in its unadjusted form, the data would be adjusted on retrieval to reflect the adjustments. For example, on retrieval of stock prices, one may like to see all data adjusted based on the current price taking into consideration the stock's split and dividend history. Using the adjusted data, the performance of the security over time can be accurately ascertained and presented to the user. Typically, the adjustments are applied using custom programming.

SUMMARY

The custom programming approach has at least two disadvantages. In the first place, each installation may have to write custom programs to solve the problem. This need to develop custom code for each database increases development costs. In addition, the performance of the resulting custom program tends to be slow. A

contributor to the slow performance is the use of multiple scans of the data to first retrieve the data and then to apply any adjustments. Another contributor is the additional memory overhead to store the data while it is being processed.

A better approach exploits the high performance of a database engine. The
5 database engine can retrieve and apply the appropriate adjustment factors for each data element in a time series. In particular, the database engine is a relational database engine. From a user's perspective, the adjustment can be applied transparently.

In a particular embodiment, a database stores a plurality of raw data values organized as a series in a first database structure. The data can be a time series of data,
10 such as financial data. A plurality of intervals of adjustment data are stored in a second database structure. The adjustment data includes an adjustment value for each interval. Furthermore, the adjustment values can be dynamically updated to reflect additional intervals of adjustment data being added to the database.

For a user to query the database for adjusted data values, the first and second
15 database structures are associated. This can be done by creating a view of the database that includes the two structures. This can be done by a system administrator. The user query then applies the adjustment values to the raw data values to yield adjusted data for presentation to a user.

The database can also store data for pending adjustments. In particular, the
20 second database structure can include adjustment data for the pending adjustment. In response to a query for adjusted data using the pending adjustment, an adjustment value for each interval can be computed using the pending adjustment data and applied to the raw data values.

BRIEF DESCRIPTION OF THE DRAWINGS

25 The foregoing and other objects, features and advantages of the system will be apparent from the following more particular description of embodiments, as illustrated in the accompanying drawings in which like reference characters refer to the same parts

throughout the different views. The drawings are not necessarily to scale, emphasis instead being placed upon illustrating the principles of the invention.

FIG. 1 is a graphical representation of a stock data time series.

FIG. 2 is a block diagram of a computing system for applying interval-based
5 adjustments.

FIG. 3 is a block diagram of the database tables of FIG. 2.

FIG. 4 is a block diagram illustrating the tables of FIG. 3 populated with data for the chart of FIG.1.

FIGs. 5A-5C are block diagrams illustrating the recording of stock split data in
10 the splits table of FIG. 4.

DETAILED DESCRIPTION

Embodiment of the system can be practiced on various time series data models, including, but not limited to, stock splits, dividend distributors, currency conversion, and expense adjustments. For ease and clarity of description, the system will be
15 described with reference to stock splits.

FIG. 1 is a graphical representation of a stock data time series. The graph illustrates hypothetical time series data, such as daily closing prices of a stock having the ticker symbol "ACME". As illustrated, the stock has undergone two stock splits, a 3-for-1 split effective on a particular date, D2, and a 2-for-1 split effective on a later
20 date, D4. A user may want to adjust the stock prices to account for the splits. This can be done by either looking forward from a date or looking backward from a date.

As an example of a forward-looking adjustment, a user may want to determine the current value of a share of stock purchased on a particular date, D1, D3, D5. A share purchased on the first date D1 at \$30/share would have a value of \$30 on that
25 date, D1. At a subsequent date D3, the stock closed at \$80/share. Because of the 3-for-1 split on the first split date D2, the user would have 3 shares, instead of 1, valued at \$240. The investment has increased 8-fold. At a still later date D5, the stock closed at \$50/share. Because of the 3-for-1 split on the first split date D2 and the 2-for-1 split on

the second split date D4, the user would have 6 shares, valued at \$300. The investment has now increased 10-fold. From the adjusted data, the user can determine the gain of the investment over time.

One example of adjusting backward in time is a moving average. The discontinuity created by the splits should be adjusted to obtain an accurate moving average. To obtain adjusted data, the prices between the split dates D2, D4 is divided by the second split factor, 2. For example, the stock at date D3 is valued at \$40/shore in the current valuation. Price data before the first split date D2 is divided by the first and second split factors, $3 \times 2 = 6$. For example, the stock at date D1 is valued at \$5/share in the current valuation.

FIG. 2 is a block diagram of a computing system for applying interval-based adjustments. As illustrated, a server computer 10 is interconnected to one or more client computers 20a,...,20N via a communications medium 5. The communications medium 5 can be any suitable medium, including wired or wireless. The communications medium 5 can directly connect the client 20 and server 10, or it can be a public communications system, such as the Internet. It should be understood, that a client-server architecture is not required for the system, the methods described herein can also be employed in a standalone computer system and in multi-tiered computing systems.

The server 10 can be a single computer or a plurality of clustered computers. The server 10 includes an operating system (OS) 12 and a database engine 14 layered over the operating system 12. Together the operating system 12 and the database engine 14 cooperate to manage a database 16. In particular, the database 16 is a relational database that stores time-series data and the database engine 14 is Oracle8i, commercially available from Oracle Corporation, Redwood Shores, California.

The database 16 can include three relational database table structures. A map table 18 maps a reference symbol to an adjustment table 19. In the particular example described below, the time-series data is daily raw (i.e., unadjusted) stock price data and the adjustments are stock splits. For this example, the reference symbol is a stock ticker symbol. The map table 18 thus maps the ticker symbol to splits table 19.

Database queries can be initiated by a client computer 20a. The server 10 uses the database engine 14 to retrieve data from the database 16 to satisfy the query. Results are returned to the client computer 20a for display to a user. These results are automatically adjusted using data from the adjustment table 19.

- 5 Methods for applying the adjustment data exploit the high performance of the relational database engine 14 to retrieve and apply the appropriate split factor for each element in a pricing time series. Furthermore, from the user's perspective, applying the split factor is performed transparently.

FIG. 3 is a block diagram of the database tables of FIG. 2. The stock table 17, as shown, includes five fields. The stock's ticker symbol is stored as text in a symbol field 17-1. The date of the trade recorded is stored in a timestamp date field 17-2. The high, low, and closing prices of the stock are stored in three numeric fields: high 17-3, low 17-4, and close 17-5. The stock table 18 includes one record for each day the stock is traded, keyed by the symbol field 17-1.

- 15 The map table 18, as shown, includes two fields: a symbol character field 18-1, and an adjustment table field 18-2. The symbol field 18-1 stores the stock ticker symbol. The adjustment table field 18-2 can be a text field or a pointer field that dereferences to the splits table 19 for the stock identified in the symbol field 18-1..

The splits table 19, as shown, includes five fields. Each record in the splits table 20 19 is associated with one interval. An effective_date date field 19-1 records the effective date of an adjustment (split) and an end_date date field 19-2 records the date of the next split adjustment. The split information for the interval between the effective date and the end date is recorded in the numerator integer field 19-3 and the denominator integer field 19-4. The factor value to convert prices during this interval 25 period to current valuations is stored in the factor numeric field 19-5.

Every time a new entry is entered into the splits table 19, reflecting a new split, the factor field 19-5 for each entry is recalculated. The factor is computed from the cumulative products of the numerators and denominators as follows:

$$\text{factor}_i = \frac{\prod_{j=i+1}^N \text{numerator}_j}{\prod_{j=i+1}^N \text{demonimator}_j}$$

where i is the entry position in the splits table 19, beginning from 1; and

N is the total number of entries in the splits table 19.

In a particular embodiment, the recalculation of the factor fields 19-5 are performed by
 5 the database engine 14 (FIG. 2) in response to the addition of a new table entry.

FIG. 4 is a block diagram illustrating the tables of FIG. 3 populated with data for the chart of FIG.1. For convenience, only the closing price data for the security "ACME" is shown in the stock table 17. The map table 18, associates the security "ACME" with an adjustment table "ACME_SPLITS_TABLE". In the splits table 19,
 10 the initial effective date, for the first interval ($i = 1$), is set equal to a sufficiently low data such as the lowest limit of the data fields, MINDATE. Likewise, the end date for the last interval is set equal to MAXDATE, which can be the upper limit of the date field. Newly announced splits are recorded in the splits table 19. As shown in the splits table 19, pricing data during the first interval must be factored by 6 to be expressed in
 15 current valuations.

FIGs. 5A-5C are block diagrams illustrating the recording of stock split data in the splits table of FIG. 4. The initial condition, before any split, is illustrated by FIG. 5A. As shown, there is one entry ($N=1$), which directs the system to retrieve data as it is, essentially by multiplying all prices between MINDATE and MAXDATE by 1.

20 After the first (3-for-1) split, the splits table 19 is illustrated by FIG. 5B. As shown, the splits table 19 has two entries ($N=2$), which direct the system to divide prices by 3 for dates between MINDATE and D2 and to divide prices by 1 for dates between D2 and MAXDATE.

After the second (2-for-1) split, the splits table 19 takes on its final form, as also
 25 illustrated by FIG. 5C. As shown, the splits table 19 has three entries ($N=3$). The

system divides prices by 6 for dates between MINDATE and D2, divides prices by 2 for dates between D2 and D4, and divides prices by 1 for dates between D4 and MAXDATE.

Structured Query Language (SQL) queries reference the splits table 19 and the stock table 17 to automatically perform price adjustments. This price adjustment is implemented with a view, which allows the transparent application of the adjustments. The SQL query makes use of the effective date field 19-1 and the end date field 19-2 to automatically and efficiently apply the appropriate split factor upon retrieval of the price date. In particular, the effective and end date columns 19-1, 19-2 are used in retrieval queries' WHERE clause to select the appropriate price adjustment from the splits table 19.

In a particular embodiment using Oracle8i, the splits table 19 is implemented as a nested table (SplitSeriesTab) of records (SplitSeriesCells). The queries posed by the user to retrieve data adjusted for splits are expressed almost identical to a SQL query that would retrieve unadjusted data. Specifically, to retrieve data adjusted for splits, the user substitutes the name of the underlying table holding the pricing data with a view. That is, the

SELECT * FROM stock_table
clause to retrieve unadjusted data, is rewritten as:
SELECT * FROM adjusted_view
to retrieve the prices adjusted for splits.

The view that accomplishes the adjustment for the price table having high and close pricing columns is:

CREATE VIEW adjusted_view (symbol, timestamp, close, high);
AS SELECT stock.symbol,
stock.timestamp,
stock.close / splits.factor,
stock.high / splits.factor
FROM stock_map map, stock_table stocks,

TABLE (cast
 (map.sf.series as TSDEV.SplitSeriesTab)) splits
 WHERE map.symbol = stocks.symbol AND
 stocks.timestamp > splits.effective_date AND
 5 stocks.timestamp < splits.end_date;

Pricing data selected from the stock table 17 is adjusted by:

- 1) dividing the price by the factor column of the splits table 19;
- 2) the appropriate split factor is determined by the WHERE clause, which chooses the split factor based on the timestamp of each pricing row; and
- 10 3) in the implementation of this view, stock_map is used to support the selection of various securities.

This view-based pricing adjustment is extremely efficient because it exploits simple range query technology of the database engine that references indexes based on the date column of the pricing table.

- 15 An administrator may also want to insert "pending splits" into the splits table. Pending splits are those that have been announced but have not yet become effective.

The previous solution relies on a split factor column that is always current, that is, the split factor column must be recomputed prior to the first retrieval of unadjusted data on or after the effective date of a new split.

- 20 There are many ways to enforce this property, such as:
- Only insert new splits on the effective date of the split. On insert, recompute the split factor column based on the cumulative product of the numerator and denominators.
 - Allow pending splits to be inserted into the splits table, but define a time-based
 - 25 trigger to recompute the split factor column at the effective_date of the pending split.

Both of these solutions require that the administrator set up the proper maintenance scripts.

Below is an alternative solution that handles pending splits, but does not require additional maintenance scripts. The solution is based on a view that recomputes the proper split factors based on the current date:

```

5  CREATE VIEW estimate_adjusted (symbol,
                                     timestamp, close, high);

    AS SELECT  stocks.symbol,
               stocks.timestamp,
10             stocks.close / (n/d),
               stocks.high / (n/d)
               FROM stock_map map, stock_table stocks,
               (SELECT PROD (split2numerator) n, PROD (split2denominator) d
                FROM TABLE
15                     stock_map map2, stock_table stocks2,
                     (cast (map.sf.series as TSDEV.SplitSeriesTab)) splits2
                WHERE map2.symbol = stocks2.symbol AND
                     splits2.effective_date < SYSDATE;)
               stocks2.timestamp > splits2.effective_date AND
20             stocks2.timestamp < splits2.end_date;
               WHERE map.symbol = stocks.symbol

```

Here, SYSDATE is the current date/time of the computing system. This view is similar to the previous view, but extended with a subquery. The subquery computes the cumulative product of numerators and denominators from the splits table.

25 It may also be desirable to apply multiple interval-based adjustments to time series data. For example, a stock price may be adjusted due to both splits and distributions. The database engine 14 can handle these multiple adjustments, either in parallel or series. First, the map table 18 can have more than one column per stock, one

dereferencing to the splits table and another dereferencing to a distribution table. To apply the adjustments in parallel, a view can be created using the multiple adjustment tables. Applying the adjustments in series may be more difficult because the adjustments should be applied in time order.

- 5 Those of ordinary skill in the art will recognize that methods involved in the interval-based adjustment system may be embodied in a computer program product that includes a computer usable medium. For example, such a computer usable medium can include a readable memory device, such as a solid state memory device, a hard drive device, a CD-ROM, a DVD-ROM, or a computer diskette, having computer readable
- 10 program code segments stored thereon. The computer readable medium can also include a communications or transmission medium, such as a bus or a communications link, either optical, wired, or wireless, having program code segments carried thereon as digital or analog data signals.

- 15 While this system has been particularly shown and described with references to particular embodiments, it will be understood by those skilled in the art that various changes in form and details may be made without departing from the scope of the invention encompassed by the appended claims.

CLAIMS

What is claimed is:

1. A method of applying interval-based adjustments to data in a database, comprising:
5 storing a plurality of raw data values organized as a series in a first database structure;
for the series of raw data values, storing a plurality of intervals of adjustment data, including an adjustment value, in a second database structure;
and
10 associating the first and second database structures so the adjustment value is applied to the series of raw data values in response to retrieval of an adjusted data value from the database.
2. The method of Claim 1 further comprising:
computing the adjustment value for each interval of adjustment data in
15 response to the addition of a subsequent interval of adjustment data.
3. The method of Claim 1 wherein associating comprises mapping the second database structure to the first database structure.
4. The method of Claim 1 wherein the raw data values represent a time series.
5. The method of Claim 4 wherein the time series tracks financial data.
20
6. The method of Claim 5 wherein the financial data is a currency valuation.
7. The method of Claim 5 wherein the financial data is a securities valuation.

8. The method of Claim 4 wherein associating comprises creating a view of the database that includes the raw data values and the adjustment value.
9. The method of Claim 1 wherein the adjustment data includes data for a pending adjustment.
- 5 10. The method of Claim 9 further comprising computing an adjustment value from the data for a pending adjustment in response to retrieval of an adjusted data value from the database.
11. A method of applying interval-based adjustments to data in a database, comprising:
 - 10 storing a plurality of raw data values organized as a time series in a first database structure;
for the time series, storing a plurality of intervals of time-based adjustment data, including an adjustment value, in a second database structure;
creating a view of the database to include the first and second database
 - 15 structures; and
in response to a query for adjusted data values, using the view to apply the adjustment value to the raw data values during retrieval of the raw data from the database.
12. The method of Claim 11 further comprising computing the adjustment value for
20 each interval of adjustment data in response to the addition of a subsequent interval of adjustment data.
13. The method of Claim 11 wherein creating the view comprises mapping the second database structure to the first database structure.

14. The method of Claim 11 wherein the time series tracks financial data.
15. The method of Claim 14 wherein the financial data is a currency valuation.
16. The method of Claim 14 wherein the financial data is a securities valuation.
- 5 17. The method of Claim 11 wherein the adjustment data includes data for a pending adjustment.
18. The method of Claim 17 further comprising computing an adjustment value from the data for a pending adjustment in response to retrieval of an adjusted data value from the database.
- 10 19. A system for applying interval-based adjustments to data in a database, comprising:
 - a first database structure storing a plurality of raw data values organized as a series;
 - a second database structure, storing a plurality of intervals of adjustment data, including an adjustment value, for the series of raw data values; and
 - 15 an association between the first and second database structures so the adjustment value is applied to the series of raw data values in response to retrieval of an adjusted data value from the database.
20. The system of Claim 19 further wherein:
 - 20 the adjustment value for each interval of adjustment data is computed in response to the addition of a subsequent interval of adjustment data.
21. The system of Claim 19 wherein the association comprises a map structure mapping the second database structure to the first database structure.

22. The system of Claim 19 wherein the raw data values represent a time series.
23. The system of Claim 22 wherein the time series tracks financial data.
24. The system of Claim 23 wherein the financial data is a currency valuation.
- 5 25. The system of Claim 23 wherein the financial data is a securities valuation.
26. The system of Claim 22 wherein the association comprises a view of the database that includes the raw data values and the adjustment value.
27. The system of Claim 17 wherein the adjustment data includes data for a pending adjustment.
- 10 28. The system of Claim 27 further comprising an adjustment value computed from the data for a pending adjustment in response to retrieval of an adjusted data value from the database.
29. A system for applying interval-based adjustments to data in a database, comprising:
- 15 a first database structure storing a plurality of raw data values organized as a time series;
- a second database structure storing a plurality of intervals of time-based adjustment data, including an adjustment value, for the time series;
- a view of the database including the first and second database structures;
- 20 and
- in response to a query for adjusted data values, using the view to apply the adjustment value to the raw data values during retrieval of the raw data from the database.

30. The system of Claim 29 wherein the adjustment value for each interval of adjustment data is computed in response to the addition of a subsequent interval of adjustment data.
- 5 31. The system of Claim 29 wherein the view comprises a map structure mapping the second database structure to the first database structure.
32. The system of Claim 29 wherein the time series tracks financial data.
33. The system of Claim 32 wherein the financial data is a currency valuation.
34. The system of Claim 32 wherein the financial data is a securities valuation.
- 10 35. The system of Claim 29 wherein the adjustment data includes data for a pending adjustment.
36. The system of Claim 35 further comprising an adjustment value computed from the data for a pending adjustment in response to retrieval of an adjusted data value from the database.
- 15 37. An article of manufacture comprising:
a computer-readable medium;
computer instructions encoded on the medium for applying interval-based adjustments to data in a database, comprising instructions for:
storing a plurality of raw data values organized as a series in a
20 first database structure;
storing a plurality of intervals of adjustment data, including an adjustment value, in a second database structure for the series of raw data values; and

associating the first and second database structures so the adjustment value is applied to the series of raw data values in response to retrieval of an adjusted data value from the database.

38. The article of Claim 37 further comprising instructions for:
5 computing the adjustment value for each interval of adjustment data in response to the addition of a subsequent interval of adjustment data.
39. The article of Claim 37 wherein associating comprises mapping the second database structure to the first database structure.
40. The article of Claim 37 wherein the raw data values represent a time series.
- 10 41. The article of Claim 40 wherein the time series tracks financial data.
42. The article of Claim 41 wherein the financial data is a currency valuation.
43. The article of Claim 41 wherein the financial data is a securities valuation.
44. The article of Claim 40 wherein associating comprises creating a view of the
15 database that includes the raw data values and the adjustment value.
45. The article of Claim 37 wherein the adjustment data includes data for a pending adjustment.
46. The article of Claim 45 further comprising instructions for computing an
20 adjustment value from the data for a pending adjustment in response to retrieval of an adjusted data value from the database.

47. An article of manufacture comprising a computer-readable medium;
computer instructions encoded on the medium for applying interval-based
adjustments to data in a database, comprising instructions for:
storing a plurality of raw data values organized as a time series in
a first database structure;
storing a plurality of intervals of time-based adjustment data,
including an adjustment value, in a second database structure for the time
series;
creating a view of the database to include the first and second
database structures; and
in response to a query for adjusted data values, using the view to
apply the adjustment value to the raw data values during retrieval of the
raw data from the database.
48. The article of Claim 47 further comprising instructions for computing the
adjustment value for each interval of adjustment data in response to the addition
of a subsequent interval of adjustment data.
49. The article of Claim 47 wherein creating the view comprises mapping the second
database structure to the first database structure.
50. The article of Claim 47 wherein the time series tracks financial data.
51. The article of Claim 50 wherein the financial data is a currency valuation.
52. The article of Claim 50 wherein the financial data is a securities valuation.
53. The article of Claim 47 wherein the adjustment data includes data for a pending
adjustment.

54. The article of Claim 53 further comprising computing an adjustment value from the data for a pending adjustment in response to retrieval of an adjusted data value from the database.

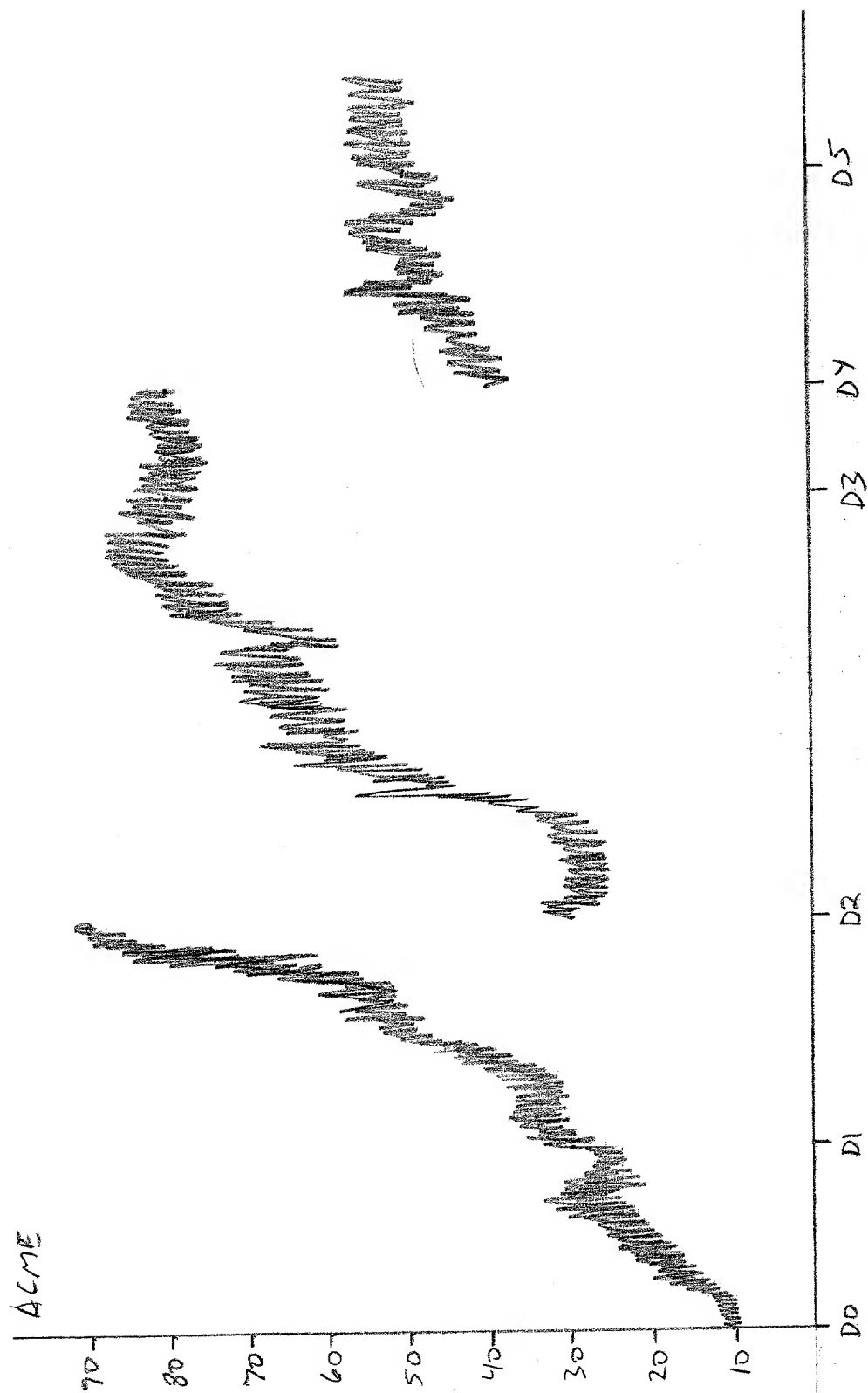
INTERVAL-BASED ADJUSTMENT SYSTEM FOR DATABASES

ABSTRACT OF THE DISCLOSURE

Interval-based adjustments to data are applied by a relational database engine.

- 5 The engine stores raw, unadjusted data values in a separate table from adjustment values. The adjustment values are dynamically updated in response to a new adjustment interval. The adjustments are applied to the raw data during retrieval from the database. This results in an efficient and transparent adjustment to data.

963



F16.1

0044333 004700 004700 004700

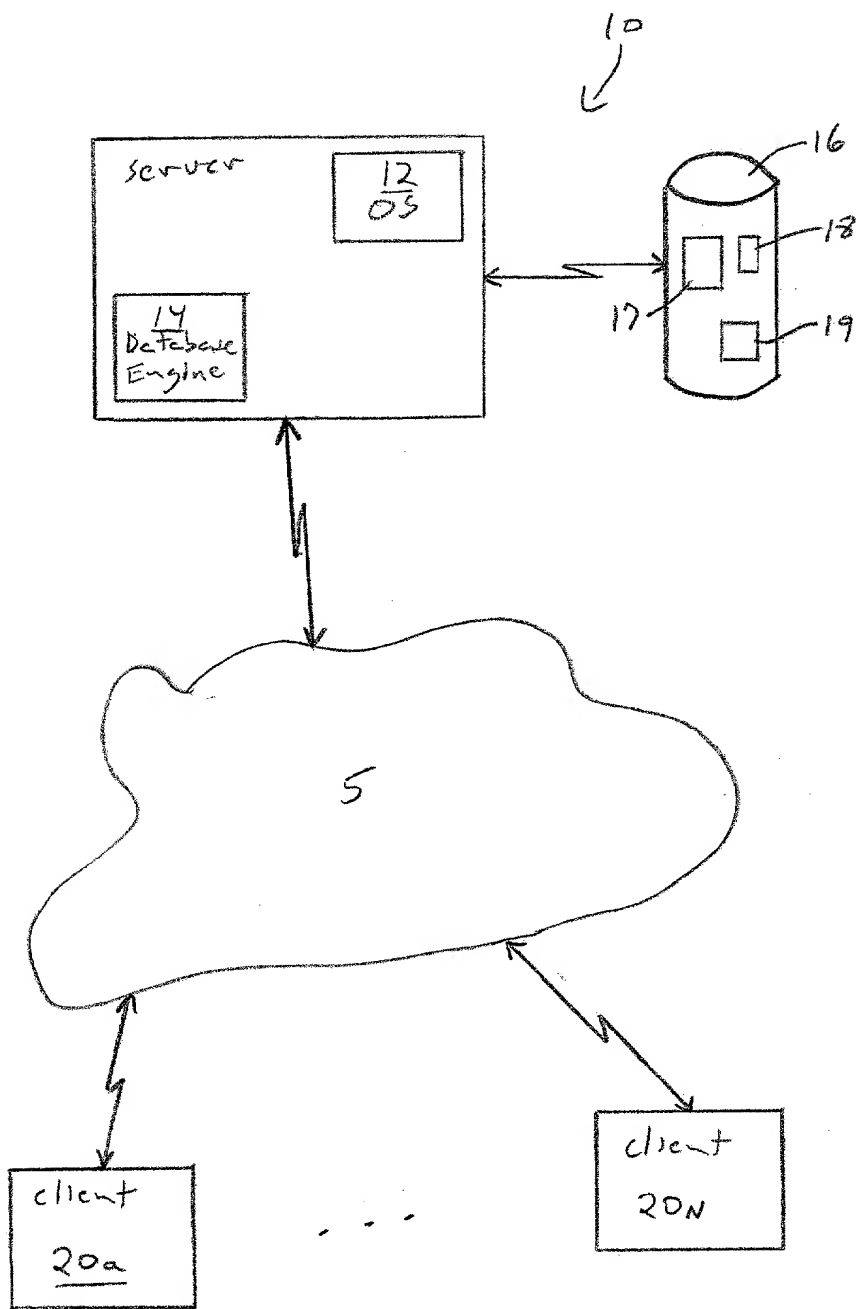


FIG. 2

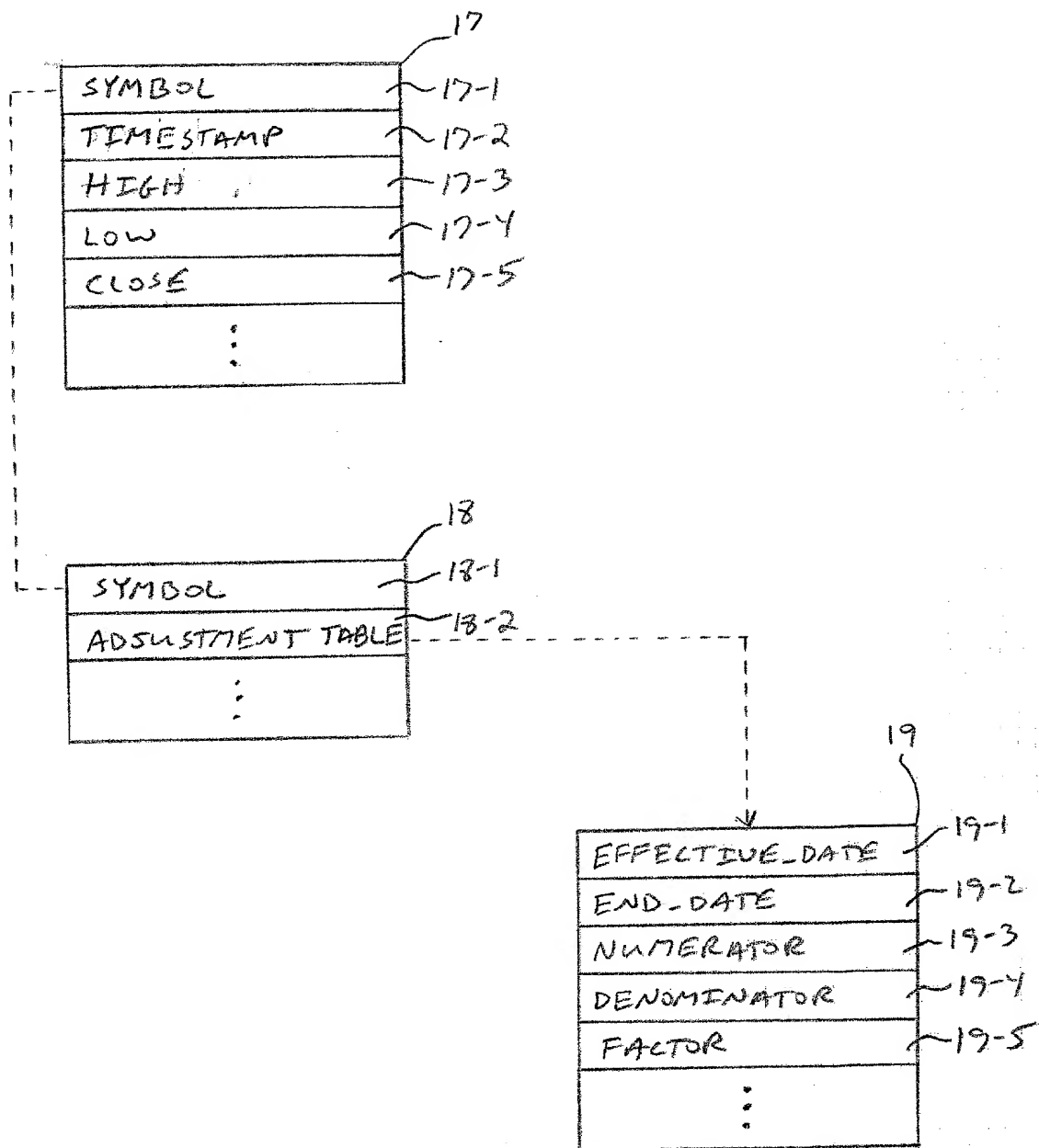


FIG. 3

STOCK TABLE				
SYMBOL	TIMESTAMP	.	.	CLOSE
		:		
ACME	D0			10
		:		
ACME	D1			30
		:		
ACME	D2			30
		:		
ACME	D3			80
		:		
ACME	D4			40
		:		
ACME	D5			50

MAP TABLE	
SYMBOL	SPLIT TABLE
:	:
ACME	ACME-SPLIT TABLE
:	:

ACME - SPLITS TABLE				
EFFECTIVE DATE	END-DATE	NUMERATOR	DENOMINATOR	FACTOR
MINDATE	D2	1	1	6
D2	D4	3	1	2
D4	MAXDATE	2	1	1

FIG. 4

19

ACME-SPLITS-TABLE				
EFFECTIVE-DATE	END-DATE	NUMERATOR	DENOMINATOR	FACTOR
MINDATE	MAXDATE	1	1	1

FIG. 5A

19

ACME-SPLITS-TABLE				
EFFECTIVE-DATE	END-DATE	NUMERATOR	DENOMINATOR	FACTOR
MINDATE	D2	1	1	3
D2	MAXDATE	3	1	1

FIG. 5B

19

ACME-SPLITS-TABLE				
EFFECTIVE-DATE	END-DATE	NUMERATOR	DENOMINATOR	FACTOR
MINDATE	D2	1	1	6
D2	D4	3	1	2
D4	MAXDATE	2	1	1

FIG. 5C

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Declaration for Patent Application

As a named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated next to my name;

I believe I am the original, first and sole inventor (if only one name is listed) or an original, first and joint inventor (if plural names are listed in the signatory page(s) commencing at page 3 hereof) of the subject matter which is claimed and for which a patent is sought on the invention entitled

Interval-Based Adjustment System for Databases

the specification of which (check one)

☒ is attached hereto.

☐ was filed on _____ as United States Application

Number or PCT International Application No. _____

and was amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is known by me to be material to patentability as defined in 37 C.F.R. §1.56.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed:

<u>Prior Foreign Application(s)</u>			Priority Not Claimed	Certified Copy Filed?	
				YES	NO
_____ (Number)	_____ (Country)	_____ (Day/Month/Year filed)	[]	[]	[]
_____ (Number)	_____ (Country)	_____ (Day/Month/Year filed)	[]	[]	[]
_____ (Number)	_____ (Country)	_____ (Day/Month/Year filed)	[]	[]	[]

I hereby claim the benefit under 35 U.S.C. §119(e) of any United States provisional application(s) listed below.

_____ (Application Number)	_____ (Filing Date)
_____ (Application Number)	_____ (Filing Date)

I hereby claim the benefit under 35 U.S.C. 120 of any United States application(s), or 365(c) of any PCT international application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. 112, I acknowledge the duty to disclose information known by me to be material to patentability as defined in 37 C.F.R. 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

_____ (Application Serial No.)	_____ (Filing date)	_____ (Status: patented, pending, abandoned)
_____ (Application Serial No.)	_____ (Filing date)	_____ (Status: patented, pending, abandoned)
_____ (Application Serial No.)	_____ (Filing date)	_____ (Status: patented, pending, abandoned)
_____ (Application Serial No.)	_____ (Filing date)	_____ (Status: patented, pending, abandoned)

As a named inventor, I hereby appoint the attorneys and/or agents associated with
Hamilton, Brook, Smith & Reynolds, P.C., Two Militia Drive, Lexington, Massachusetts 02421-4799
Customer No. 21005,

and _____,

to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith.

Please send correspondence to:

☒ **Customer No. 21005**
HAMILTON, BROOK, SMITH & REYNOLDS, P.C.
Two Militia Drive
Lexington, MA 02421-4799

or

☐ **Address as follows:**

Direct telephone calls to: Rodney D. Johnson Telephone No.: 781-861-6240

Direct facsimiles to: Rodney D. Johnson Facsimile No.: 781-861-9540

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of sole

or first inventor Lory Molesky

Inventor's Signature _____ Date _____

Residence 3 Apache Trail

Arlington, Massachusetts 02074

Citizenship USA

Post Office Address (same as above)

Full name of second joint

inventor, if any Robert Hanckel

Inventor's Signature Robert Hanckel Date August 10, 2000

Residence 622 Midhurst Road

Nashua, New Hampshire 03062

Citizenship USA

Post Office Address (same as above)

::ODMA\MHODMA\iManage;150952;1



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Declaration for Patent Application

As a named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated next to my name;

I believe I am the original, first and sole inventor (if only one name is listed) or an original, first and joint inventor (if plural names are listed in the signatory page(s) commencing at page 3 hereof) of the subject matter which is claimed and for which a patent is sought on the invention entitled

Interval-Based Adjustment System for Databases

the specification of which (check one)

☒ is attached hereto.

☐ was filed on _____ as United States Application

Number or PCT International Application No. _____

and was amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is known by me to be material to patentability as defined in 37 C.F.R. §1.56.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed:

<u>Prior Foreign Application(s)</u>			Priority Not Claimed	Certified Copy Filed?	
				YES	NO
_____ (Number)	_____ (Country)	_____ (Day/Month/Year filed)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
_____ (Number)	_____ (Country)	_____ (Day/Month/Year filed)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
_____ (Number)	_____ (Country)	_____ (Day/Month/Year filed)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

I hereby claim the benefit under 35 U.S.C. §119(e) of any United States provisional application(s) listed below.

_____ (Application Number)	_____ (Filing Date)
_____ (Application Number)	_____ (Filing Date)

I hereby claim the benefit under 35 U.S.C. 120 of any United States application(s), or 365(c) of any PCT international application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. 112, I acknowledge the duty to disclose information known by me to be material to patentability as defined in 37 C.F.R. 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

(Application Serial No.)	(Filing date)	(Status: patented, pending, abandoned)
(Application Serial No.)	(Filing date)	(Status: patented, pending, abandoned)
(Application Serial No.)	(Filing date)	(Status: patented, pending, abandoned)
(Application Serial No.)	(Filing date)	(Status: patented, pending, abandoned)

As a named inventor, I hereby appoint the attorneys and/or agents associated with
Hamilton, Brook, Smith & Reynolds, P.C., Two Militia Drive, Lexington, Massachusetts 02421-4799
Customer No. 21005,

and _____,

to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith.

Please send correspondence to:

☒ **Customer No. 21005**
HAMILTON, BROOK, SMITH & REYNOLDS, P.C.
Two Militia Drive
Lexington, MA 02421-4799

or

☐ **Address as follows:**

Direct telephone calls to: Rodney D. Johnson Telephone No.: 781-861-6240

Direct facsimiles to: Rodney D. Johnson Facsimile No.: 781-861-9540

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of sole

or first inventor Lory Molesky

Inventor's Signature  Date _____

Residence 3 Apache Trail

Arlington, Massachusetts 02074

Citizenship USA

Post Office Address (same as above)

Full name of second joint

inventor, if any Robert Hanckel

Inventor's Signature _____ Date _____

Residence _____

Citizenship _____

Post Office Address _____

::ODMA\MHODMA\iManage;150952;1